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Failure of Joints between Concrete Wall Panels

Rupture de joints entre panneaux en béton préfabriqué

Bruch der Verbindungen zwischen Betonwänden

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1. ABSTRACT

The construction of homes and multi-storey buildings with large precast wall elements has generated numerous problems; especially in the design of weather-proof joints between the external panels. This study examines the penetration of air and water through these joints.

2. INTRODUCTION

Joints between prefabricated concrete elements forming the external cladding of a building have to withstand rain, wind pressure, exposure to radiation and movements due to changes in the temperature and moisture of the concrete. These differential movements account for the intrusion of wind and rain through the joints. The increase in the incidence of failure of these joints has resulted in costly repairs and in the demolition of some relatively new building complexes.

This study investigates the penetration of wind and rain through a single stage closed joint and a two stage open drained joint (figs 1&2). The measurements are obtained with a laser Doppler anemometer (LDA) [1] and the computer predictions are based on the K ϵ mathematical model of turbulence [2].

3. METHOD

The fluid flow associated with the geometries considered is turbulent, separated and recirculating. The measurement of the flow is achieved with an LDA method which is non-intrusive and responds to the continuously reversing flow within the joints. All the experimental work is done on full-size sectional models of building joints placed in a wind tunnel that simulates natural wind.

The predictive method is based on the K ϵ mathematical model of turbulence; the two differential equations solved are dependent on the Kinetic energy K and its dissipation rate ϵ . The boundary conditions are specified from the experimental measurements.

4. RESULTS & CONCLUSIONS

The experimental measurements (fig 3) and the predicted results (fig 4) show that the vortex system inside the joint is strongly dependent on the aspect ratio of the geometry and the nature of the approach flow. This information on the vortex system is necessary in locating where rain is deposited within



the joint. Most of the water entering the joint is deposited in the region of the primary vortex therefore any drainage system positioned behind this eddy will be effective in keeping the internal seal dry. The results presented are of wind flow parallel to the face of the joint, the case when the flow is incident at a different angle is more complex. The problem can, however, be made easy by putting a rain barrier outside the joint (fig 5). This external rain barrier has the dual purpose of stopping direct entry of rain drops, but more important, channels the flow parallel to the face of the joint. Consequently the position of the primary eddy and therefore water deposition is easily determined.

REFERENCES

- [1] Durst F et al, Principle and practice of LDA Academic Press, 1981
- [2] LAUNDER B.E et al, Mathematical models of turbulence Academic Press, 1972

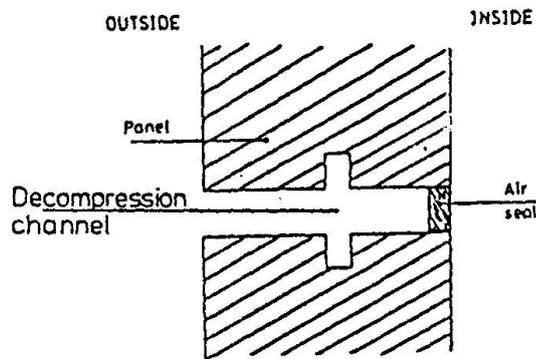
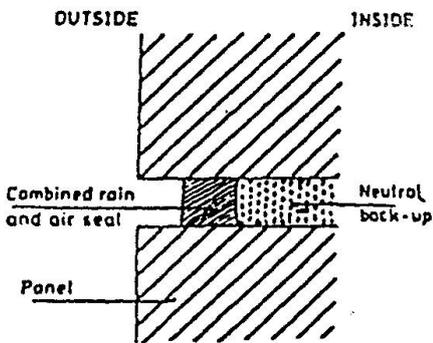


Fig1: A single stage closed joint between two building panels.

Fig2: A two stage open joint between two building panels.

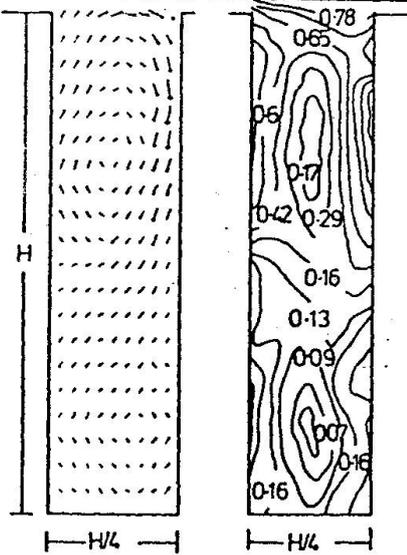


Fig 3 : Velocity vectors & contours in a deep joint (L.D.A measurements)

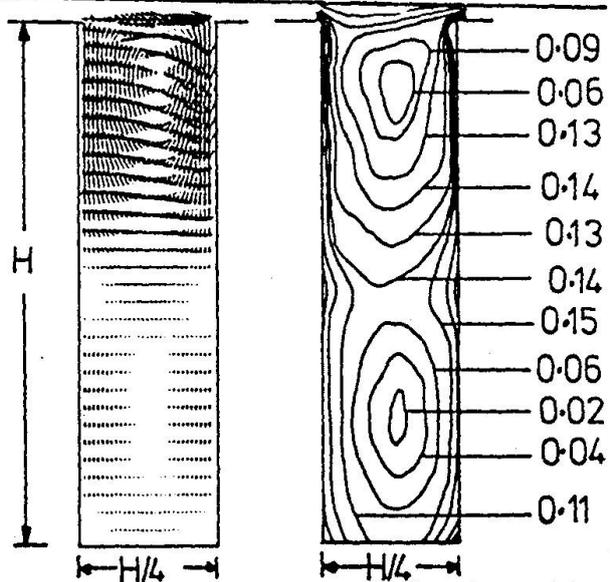


Fig 4 : Velocity vectors & contours in a deep joint (prediction with K.E model)

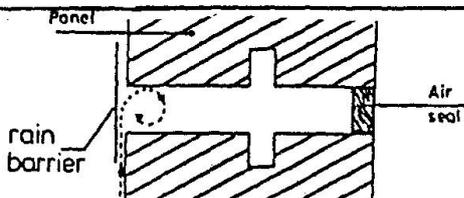


Fig 5 : A two stage open joint with an external rain barrier